

# European User Trial of Paging by Satellite

R E Fudge and C J Fenton  
British Telecom,  
Mobile Communications, Mobile House,  
Euston, LONDON NW1 2DW United Kingdom  
Phone +44-71-388-4222

## 1. INTRODUCTION

Satellite communication to land mobiles is still in its infancy due to the combined limitations of economic satellite ERP and the ability to accommodate suitable antennas on vehicles. The latter factor is a particular constraint for two-way transmission, since small antennas not only give a poor link budget but also cause 'pollution' of the geostationary orbit. If however, only one-way transmission is considered then it becomes obvious that currently available satellite performance and the use of an acceptably sized antenna would be able to support a low speed data service.

Ideally such a data service would have its modulation and coding constructed in a way that made optimum use for the satellite channel characteristics. If such a modulation/coding scheme were to be implemented then users would have to bear the cost of production and development of such specialised terminals.

British Telecom conceived the idea of adapting their existing paging service, together with the use of existing terrestrial pagers, to yield a one-way data (ie paging) satellite service to mobiles. This was recognised as not providing the absolute best use of the channel, but the degradation was small and economically tolerable.(1)

A series of design studies, and, technical evaluations were carried out which lead to the

conduct of an user trial and this is reported on here.

## 2. SYSTEM CONFIGURATION

The system design was based on the maximum use of the existing British Telecom terrestrial paging system and the use of normal terrestrial paging terminals.

The present paging network consists of 450 base sites. These radiate in the VHF region (153 MHz) and give an extensive coverage in the UK, reaching 98% of the population. A variety of services are offered from simple tone page, through numeric page, to full alpha-numeric message transmission of 90 characters. Standard pagers are used based on POCSAG protocols (CCIR Radiopaging Code No 1). Originally, these operated at 512 bits/sec and more recently at 1200 bit/sec. Paging users elect to take service from a number of geographic zones. An initiating call can be made either directly to the control system (PACE) in the case of tone pagers, or to a bureau for numeric or alpha-numeric paging.

The satellite service used the same protocols and modulation. The paging network was configured with an extra zone, termed 'satellite zone', and the network signals from this were fed to the Goonhilly Earth Station. Here they were modulated in the normal way on to a terrestrial paging carrier and this was up-converted to the satellite uplink frequency. The satellite down link at L-band

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was received by the tubular quadrifilar helix mobile antenna (omni directional) and then down converted to the standard 153 MHz paging frequency. This signal was inductively coupled into a normal 'message master' pager having a 90 character display. The network configuration is shown in figure 1.

The pager and its coupling were mounted in the cab of a vehicle, remote from the down converter if desired, and the housing of the pager also contained a printer which derived its information from the pager and provided a hard copy of received messages.

This configuration had a number of user advantages. The pager owner could use his pager in the terrestrial mode when desired, eg by clipping to his belt or carrying in pocket or handbag and in this mode he would obtain the normal paging service in the UK with its extensive coverage in urban areas, into buildings and into vehicles. When in his vehicle outside the normal coverage areas he could place the pager in the vehicle adapter. This then gave him coverage of all other areas of UK, and moreover allowed the vehicle to roam freely over the whole of Europe. In addition the call originator could use the normal mode of message initiation; either by speaking to the message bureau or accessing the paging network via the public data networks. The paging number remains the same whether in terrestrial or satellite mode and the caller does not need to know the location of the user.

### 3. OUTLINE OF TECHNICAL RESULTS

The system concept was first evaluated by way of technical trials in order to have an understanding of the nature of the channel and of the service which might be provided. This was a necessary first step prior to the user trials, and served to both prove the system and

ensure that potential users would have the benefits of our prior experience.

These technical trials have been reported on in detail.(2) In summary they showed that full message fidelity was always achieved when stationary in open areas. Motion in itself had no visible effect, but the shadowing caused by trees, over-bridges and dense urban areas was noticeable in generating message errors. However these were less than might have been expected:- in urban areas 65% of messages were received with no errors and 90% were received with some corruption. No variations due to satellite elevation were detected on runs conducted in the UK.

The overall system performed well and it was considered that a viable user trial could be mounted; the service would be angled towards long-distance truckers who are most likely to be on open freeways rather than in urban areas.

### 4. CONDUCT OF USER TRIALS

The trial had the objectives of learning the marketing requirements, and of assessing the ability of the system to provide a service. It also provided potential customers with an introduction to the service and the engineers with an assessment of installation problems. Fig 2 shows an installation with the antenna mounted on the back of the truck cab.

To achieve these objectives users were selected who operated widely a) in the UK, b) within another European country, c) across national boundaries including the use of ferries. Fig 3 shows a map of the area of operation. Reports were obtained from the fleet operators, the fleet controllers, and of course from the drivers. Table 1 shows the parameters of the trial.

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## 5. RESULTS OF TRIAL

No significant problems were encountered during vehicle fitting, this was carried out in depots in the UK and in The Netherlands. Figure 3 shows a rear view of the cab of an articulated unit with antenna showing above the roof.

Overall the system performed well over the 4 months with no network, or satellite segment, problems. The vehicles were in extensive use for at least 5 days per week. It was judged that some 60% of messages were received correctly, and this should be reviewed against a background of some resistance to the use of the system by drivers. They had some feeling that the installation of the system in 'their' cab called into question their competence and ability to judge situations for themselves. It was very much welcomed by the car user (a salesman, for the products transported by the trucks), by the fleet controllers, and by the fleet managers.

There was a desire to have acknowledgement of correct receipt of messages, especially if these contained safety information - this use was seen as a great benefit. Particular problems were encountered with customs officers at borders who regard the installation as probably contravening the radio/licensing regulations of that country. This happened despite the fact that the apparatus was for

receiving only and that the driver carried a card showing the approval and agreement of all authorities concerned to allow this experimental equipment to be used (The CEPT Card).

## 6. CONCLUSIONS

The user trial of paging by satellite was successful. It demonstrated that services could be provided over a very wide geographical area to low priced terminals.

Many lessons were learned in, perhaps unexpected, areas. These included the need for extensive liaison with all users involved, especially the drivers, to ensure they understood the potential benefits. There was a significant desire for a return acknowledgement channel or even a return data channel. Above all there is a need to ensure that the equipment can be taken across European borders and legitimately used in all European countries.

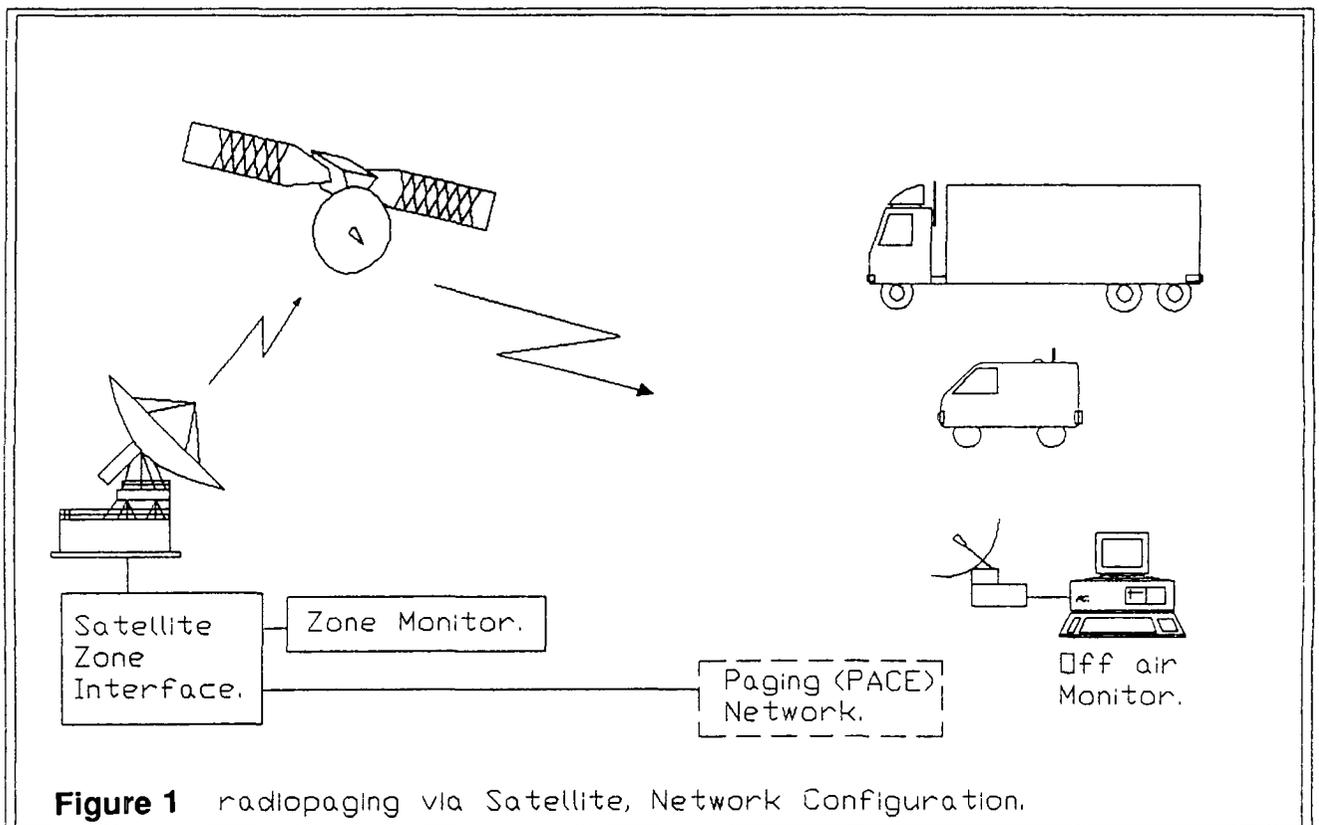
The next step in a marketing assessment would be to consider the impact of two-way data messaging such as INMARSAT-C.

### References

1. **McClure, I.** *Lift Off for the Space Page*, British Telecom Journal, Vol8 No.4.
2. **Fenton, C J & Fudge, R E.** 1989 *Evaluational of Radiopaging Via Satellite*. IEE Land Mobile Radio Conference, Warwick.

**TABLE 1 USER TRIAL PARAMETERS**

Trial duration	4 months
Vehicles used	7 trucks, 1 car
Installation time	2 hours
System availability	7 days per week 24 hours per day
Access from call originator	Telex
Countries covered	UK, Netherlands, France, Belgium, West Germany
Total number of messages	2,000
Message success rate	60% overall



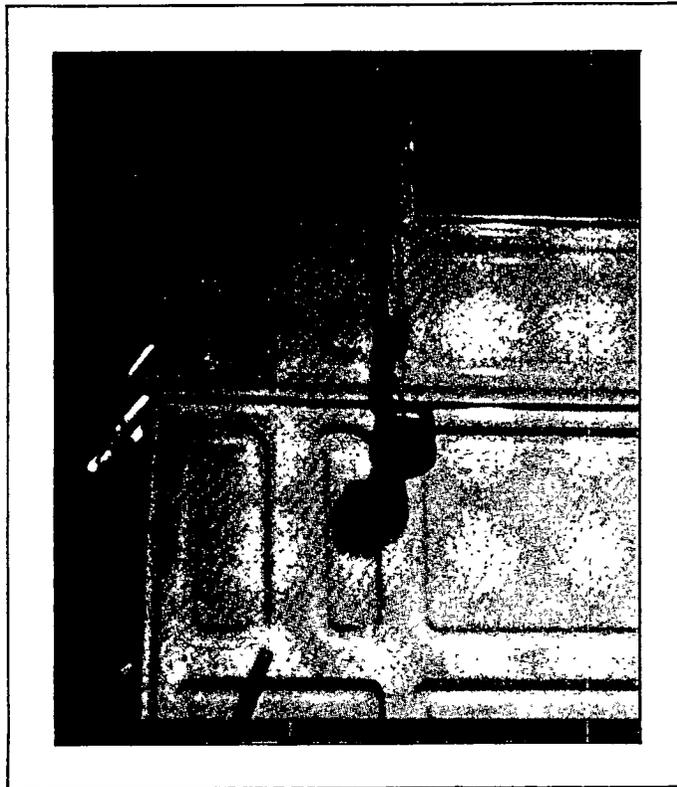


Figure 2



Figure 3